Explaining public acceptance of congestion charging: the role of geographical variation in the Bergen case

Abstract

Controversial policies introduced to improve public goods - such as the environment, mobility and public health - have shown patterns of initial opposition followed by broad acceptance once the public experiences positive effects of the policies. In transport policy, congestion charging is one area where such a pattern has been observed, particularly in some high-profile cases like Stockholm and London. However, existing research tends to focus on success cases and aggregate outcomes, and geographical variation in support and opposition is often overlooked. This is problematic because the public opinion on congestion charging appears highly differentiated between different areas of cities, possibly corresponding to perceived misdistribution of costs and benefits. We present a before-after study conducted in connection with the introduction of time-differentiated congestion charging rates in Bergen, Norway, in 2016. We find a substantial reduction of congestion and travel times after the policy's implementation, but our survey data show no overall increase in policy support after implementation. There is, however, a tendency toward higher support for congestion charging in boroughs with greater delay reductions. We conclude that in securing and maintaining public support for transport measures, the intra-city distribution of costs and benefits is of critical importance.

Keywords: congestion charging, road tolls, road pricing, public opinion, acceptability, Norway

1. Introduction

In recent years there have been several high-profile examples of how policies to improve public goods have overcome initial public opposition and achieved broad public acceptance. Examples include policies for the environment, mobility and public health. The banning of indoor smoking in all work places proposed by New York City Mayor Michael Bloomberg in 2002 constitutes perhaps the best-known example illustrating how people went from strongly opposing to being satisfied with a controversial policy. Initially, New Yorkers could hardly imagine a society where one could not smoke inside a bar, but accepted the policy change after experiencing its positive effects. Another example is the implementation of a CO_2 tax in the Canadian province of British Colombia (Murray and Rivers, 2015). In both cases, initial public skepticism, or outright opposition, turned into increased support post-implementation (Weber, 2015).

The dynamics of public opinion is of significant interest to transport policy, where there are obvious public goods that could be improved through policies related to the environment and public transportation. Congestion charging is one policy area where this pattern of initial opposition turned to broad public acceptance has been observed, particularly in some high-profile cases like Stockholm and London (Hugosson, Sjöberg, *et al*., 2006; Transport for London, 2008). Congestion charging is an instrument used in cities to reduce traffic jams by surcharging users at certain times of the day. Higher toll levels at peak hours reduce demand for a scarce resource – road space – by incentivizing drivers to switch to other modes of transportation, driving at other times of the day, or reducing their travel outright. The long-term goal is better accessibility and reduced air pollution (Nordheim, Haug, *et al*., 2010).

A range of studies have used Stockholm as a case (Eliasson 2008; Hysing and Isakson 2015; Schuitema, Steg and Forward, 2010), showing that people in the city went from opposition to acceptance after witnessing a positive change. This change could not have been properly imagined beforehand, and an unpopular stage was thus necessary to produce an ultimately popular policy. Eliasson found that when people in hindsight were asked what changed their minds about congestion charging, more than half of the people said that they had not changed their minds, even though they had demonstrably done so (Eliasson, 2008). The Stockholm example points to a more general insight about preferences related to new and untested proposals.

Not all congestion charging implementation follow this pattern. The public also rejected a congestion charge proposal in Gothenburg after a consultative referendum based on a trial period in 2013 (Hansla, Hysing, *et al*., 2017). And congestion charging proposals have in several cities, including Lyon, Hong Kong, Edinburgh, New York and Greater Manchester, been stopped at different stages of the process (Raux and Souche, 2004; Hau, 1990; Confessore, 2008; Hansla, Hysing, *et al*., 2017). Cases and contextual factors vary significantly, and as Hysing and Isaksson (2015) suggest, local implementation is highly conditional upon these factors.

Therefore, further case studies can enrich our understanding of the links between implementation of congestion charging and the social dynamics of acceptance and opposition. We argue that the existing research on the implementation of congestion charging tends to focus on success cases and aggregate outcomes. This means that some critical factors, particularly geographical variation in support and opposition, are overlooked. This is problematic because the sustainability of the policy regimes is dependent upon stable and broad support, and even minor opposition can constitute significant implementation barriers (Schaller, 2010).

In our case study of congestion charge implementation in Bergen, Norway – an international front-runner in road pricing policy – we use several data types to assess both temporal and geographical variation in public support. This enables us to link changes in public support to the specific boroughs that have experienced reduced congestion after implementation. In turn, that permits a more detailed analysis of the interplays between implementation, public acceptance, and reduced congestion. On this basis, we argue that in implementing congestion charging and other potentially controversial transport policies, the intra-city distribution of costs and benefits is of critical importance.

The article proceeds as follows. In the following section (section 2), we review existing research on congestion charging. Then (section 3) we introduce the case of Bergen, and provide an overview of materials and methods (section 4) used in the research presented. Subsequently we present the results of our empirical analysis (section 5). Finally we discuss our results (section 6) and draw out the broader conclusions of the article (section 7).

2. Understanding variation in acceptance of congestion charging

In this paper, we count as congestion charging only the systems with time-differentiated rates designed to smooth traffic flows throughout the day. By contrast, toll roads with flat fees are generally intended to raise revenue only and not to affect traffic patterns, and we do not count such systems as congestion charging. Congestion charging can potentially mediate several transport problems, particularly related to efficient mobility, health, and the environment. The transport sector is responsible for approximately 23 per cent of global energy-related carbon dioxide (CO_2) emissions (Sims, Schaeffer *et al*., 2014). Particularly in cities, local pollution from the combustion of gasoline and diesel is a pressing environmental problem causing millions of premature deaths (e.g. Lelieveld, Evans *et al.* 2015).

In large cities, commuters spend hours stuck in traffic, time that could have been spent more productively either at work or as leisure. As a consequence, businesses worldwide lose considerable amounts of money due to traffic congestion (Cookson and Pishue, 2017). Experiences with the introduction of congestion charging in cities like London and Stockholm have shown significant reductions in traffic ranging from 15-21 per cent (Santos, Li, *et al*., 2004;

Beevers and Carslaw, 2005; Eliasson, Johnson, *et al*., 2009). In Stockholm, delays in rush hours were reduced by 30 to 50 per cent, the CO_2 emissions in the inner city were reduced by 14 per cent, the local pollution was reduced by 8-14 per cent, and the number of traffic injuries decreased.

Positive results have generated significant attention in policy circles, and a research literature investigating various aspects of public acceptability. Schuitema and co-authors (2010) found that before introduction of the charge in Stockholm, acceptability was lower when respondents believed their travel costs would increase. While after the introduction of the charge, perceived travel costs were not significantly related to acceptance. The literature has also shown that attitudes towards implemented charges are not necessarily formed by rational cost-benefit analyses, but are influenced by perceived environmental outcomes and knowledge of transport-related problems (Nilsson, Schuitema, *et al*., 2016). Other contributions, such as Sørensen and co-authors (2014), explain different outcomes between cases through the different ways barriers of public perception have been managed politically. Among other success factors, they point to the importance of communicating with the public, particularly those who oppose, and the use of trails to increase legitimacy and acceptance.

As this literature illustrates, public acceptance for congestion charging has varied between cases. London introduced congestion charging in February 2003, due to a major congestion problem in the inner city. Before introducing the charge, 300 extra buses were introduced to the congestion charging zone. Results showed a decrease in congestion of 21 per cent from 2002 to 2007, and the delay caused by heavy traffic was reduced by 26 per cent. Bus transport increased by 31 per cent and bicycle transport by 66 per cent. The punctuality of the buses was also much improved by the charging system. Some scholars argue that the success in London is due to the active engagement in outreach, public consultations and stakeholder involvement, also as a part of election campaigns. This contributed to building and maintaining public acceptance (Banister, 2003; Livingstone, 2004).

The Stockholm congestion charging trial was introduced in April 2005 and lasted for seven months. The main goal of the trial was to reduce congestion in the city center and improve the environment around it. The trial had two elements: increasing public transportation and congestion charging (Eliasson, Hultkrantz *et al*., 2009). The outcome of the trial showed a 20-25 per cent reduction of traffic in and out of the city center, time spent in congested traffic went down with 30-50 per cent in and around the city center, and the emissions of environmental gases went down 14 per cent in the city center and 2.5 per cent in the municipality as a whole. Before the congestion charging trial began (August 2005), a survey revealed that a majority of 55 per cent of the people in the county of Stockholm thought of congestion charging as "a bad idea" or "a very bad idea". This changed after the trial period (April 2006), when 53 per cent thought of the system as "a good idea" or "a very good idea" (Aas, Minken and Samstad, 2009). After a referendum in 2006, the system tested in the trial period was made permanent, starting in August 2007. In 2016 the prices were increased and a new area with high traffic volumes, Essingeleden, was included in the charging system. Isaksson and Richardson (2009) argue that organizing a referendum was part of an effective and important strategy to increase the public acceptability.

For both Stockholm and London, the hypothesis that "familiarity breeds acceptability" is the most used to explain the success (Eliasson and Jonsson, 2011). In the context of societal change, energy transformation and controversial policymaking, some psychologists argue that people are driven by habits, emotions, and personal experience rather than cost-benefit analysis (Weber, 2015). This means that people in decision-making processes evaluate evidence for several actions, and then – depending on the balance of evidence – decide what to do or what attitude to adopt. These decisions could be conscious, but also unconscious as a result of habits, past experience or emotions. Empirical findings also show that the first thing to be considered is also the most crucial one, as people generate more evidence for it (Johnson, Haubl, and Keinan, 2007; Weber, Johnson, *et al*., 2007). Further, the first choice option to be considered is very often the *status quo.* This is why this type of judgement error often is referred to as the status quo bias. This *status quo* bias is an established psychological explanation behind Eliasson and Jonsson's (2011) hypothesis that "familiarity breeds acceptability".

However, we would conjecture that there is more to it than this – people do not necessarily accept all policies that they are familiar with (e.g., see Hansla, Hysing, *et al*., 2017). In the case study at hand, Bergen, road pricing has been around for more than three decades – and there is still significant opposition, as we will return to. It appears from local media coverage that opposition comes from residents in outer boroughs, who claim to bear much of the cost of road pricing yet get few benefits from the public transport infrastructure it finances. It seems to us that geographical distribution of costs and benefits is a critical factor behind public support, and worthy of further study. More work is needed to understand variation in acceptability across different segments of the population, as benefits and costs are distributed unevenly (Sims, Schaeffer, *et al*., 2014). In the multiple case studies of Stockholm, Beijing, London, New York and some other cities, this factor has been alluded to but not properly investigated (Schaller, 2010; Schuitema, Steg and Forward, 2010; Linn, Wang and Xie, 2016). Therefore, we need to examine geographical variation in real and perceived costs and benefits.

3. Congestion charging: the case of Bergen

To better understand the socio-demographic and geographic dynamics of public opinion on congestion charging, we present a before-after study of the introduction of time-differentiated congestion charging rates in Bergen, Norway, in 2016 (Aas, Minken and Samstad, 2009). Toll roads are increasingly used in Norway as part of financing policy packages where state, regional and municipal authorities join forces to solve transport and mobility challenge in the largest cities. In turn, part of the income from toll roads and congestion charging goes to public transport investments.

In 1986, Bergen became the first city in Europe to introduce the principle of requiring car users to pay for road construction through a ring of toll booths around the city center. The scheme was introduced to provide supplementary funding for road projects in the city (Tretvik, 2003). A newspaper poll revealed that the public opinion about the new toll ring in Bergen had a majority of people (54 per cent) opposing the new toll ring with only 13 per cent in favor. This changed within a year, with 50 per cent in favor and 36.5 per cent opposed (Larsen, 1988). The author argues that this change in opinion was due to people not experiencing the queues at the tollgates that they feared, and that the authorities were able to point out the scheme's positive effects in the form of visible road improvements.

Until the congestion charging system was introduced in February 2016, the pricing system charged car users the same fee during the whole day. There was thus no economic incentive for choosing another time of travel than planned. From February 1, the toll booth fee was increased by 80 per cent in rush hour and reduced by 24 per cent out of rush hour, on weekends and holidays (See Table 1). Rush hour is defined as 06.30 to 09.00, and from 14.30 to 16.30 (typical Norwegian workday is 08 to 16). The policy change was passed at all three levels of government: city council, county council, and national parliament – all by comfortable majorities.

Some modifications soften the impact for high-volume users. One rule states that cars can pass the toll booth an unlimited number of times within one hour, and still pay for only one passage. A monthly ceiling means that heavy users will pay for a maximum of 60 passages.

Electric cars, emergency vehicles, buses and others with exemption still pass free of charge, as before February 2016 (Presterud, 2017).

The introduction of road pricing has not been without protests. A civic movement called "Enough is enough!" (*"Nok er nok!"*) has emerged in Bergen as a reaction to congestion charging and to toll price levels more generally. The movement has arranged several visible protests in the streets of Bergen. It has also announced plans to run an independent list of candidates for the Bergen city council in the municipal elections of 2019 (Haga, 2018).

Table 1

Overview over road toll levels (one way) before and after the introduction of congestion charging, February 2016 (euro conversion is approximate)

	Light vehicles	Heavy vehicles
Previous flat fee	NOK 25 (€2.5)	NOK 50 (€5)
Congestion charge: Peak	NOK 45 (€4.5)	NOK 90 (€9)
Congestion charge: Off-peak	NOK 19 (€1.9)	NOK 38 (€3.8)

Using both traffic measurements and data on public opinion, we seek to find if the congestion went down, and if the public support improved. Further, we want to look for a potential link between the two previous questions. Finally: What segments of the population in Bergen supported/opposed the toll changes, and why?

4. Material and methods

4.1 Traffic measurements

The Norwegian National Public Roads Administration provides traffic information at 5-minute intervals over major stretches of road. For this analysis, we used data between July 2014 and March 2018 for twenty-two stretches of road leading in and out of Bergen. The stretches of road that were selected met several criteria: they had no overlap but combined to provide a representative picture of traffic conditions within and between the boroughs of the city and there were no major breaks or inhomogeneity in the data. Data were not included for Northern and Southern suburbs during the period from July to October 2016 because a key measurement station was not operating. The Roads Administration collects information about the number of vehicles in each stretch of road, the travel time and the delay time. This information was used to calculate several key metrics:

- The total vehicle travel time and total delay time in seconds. The data were aggregated into fifteen-minute intervals to match the toll pricing periods and used to show changes in traffic patterns as a function of time-of-day.
- The fraction of travel time spent in traffic queues in percent.

The fraction of time spent in traffic delays gives a sense of the magnitude of the traffic problem by sub-region, which can in turn help explain the public's view of the efficiency toll system. Changes in the time spent in queues after February 1, 2016 provides a measure of the success of the new toll structure. We express delay in terms of seconds lost relative to unhindered traffic, and standardize delay by comparing seconds lost on each stretch of road to total travel time. The monitored stretches are grouped by their associated general directions relative to the city center, North, South, and West.[1]

4.2 Public opinion

The survey data come from five original surveys commissioned by the authors, using representative samples of individuals residing in Bergen. The samples were drawn randomly from a telephone register. The surveys were conducted by telephone, and were repeated five times: in December 2015, in January 2016, in February 2016, in March 2017 and in February 2018. The first two took place before the introduction of congestion charging on 1 February 2016; the three last surveys were conducted after introduction. The main question had the following wording:

> *The city of Bergen [is going to introduce]/[has introduced] a system where passing the toll ring during rush hour costs more, and less when outside of rush hour. Are you positive or negative to this charging scheme?*[2]

The answer options were:

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[1] There is no direct road to the Eastern suburbs due to a mountain range, and most commuters thus access the city center via the northern suburbs, via a southern route, or by rail through a tunnel.

[2] Original wording before introduction: «Kommunen skal innføre en ordning der det vil koste mer å passere bompengeringen i rushtiden, og koste mindre utenom rushtiden. Stiller du deg positiv eller negativ til en slik ordning?»
Original wording after introduction: «Bergen kommune har innført en ordning der det koster mer å passere bompengeringen i rushtiden, og koster mindre utenom rushtiden. Stiller du deg positiv eller negativ til denne ordningen?»
Common response scale read out: «Du kan svare med et tall på en skal fra 1 til 7, der 1 betyr svært negativ og 7 betyr svært positiv. 0 = Ikke sikker»

1 (very negative) – 7 (very positive)

0 = not sure

The survey furthermore included questions about basic demographic information. The number of respondents in each survey ranged from 600 to 639. Of the 3,044 participants, 50 per cent (n = 1241) where women. Of the 72 per cent (n = 1,762) who worked, 30 per cent (n = 743) worked in the public sector and 42 per cent (n = 1,019) in the private sector.[3] Table 2 shows further descriptive statistics of the sample.

Table 2

Descriptive Statistics

Support for congestion charging	M=3.81 (n=2,931)	SD=2.24	1 (very negative) - 7 (very positive)
Age (years)	M=35.08 (n=3,044)	SD=17.99	14-99
Yearly household income before tax (NOK)	(n=2,592)		
<500,000 (€54,750)	28%		
500,000-750,000 (€54,750 – €82,125)	20%		
750,000-1 million (€82,125 - - €109,500)	22%		
>1 million (€109,500)	30%		
Secondary education	(*n*=3,044)		

[3] This question was not measured in the last round, February 2018.

<2 years	27%
4-6 years	35%
>6 years	38%

5. Results

5.1 Impact on traffic congestion

Figure 1 shows traffic delays[4] before and after the toll pricing change as well as the change in delays as a function of time of day. Data were aggregated into 15 minute intervals over a 5-month period before and after the introduction of the time-differentiated toll levels.

[4] The Norwegian Roads Administration provides travel delays and the number of vehicles observed in each road segment in five minute intervals. A delay occurs only if the observed average travel time in a segment exceeds the reference travel time. Periods with vehicle speeds faster than normal are ignored and not counted against the travel delays. The total travel delay is calculated by multiplying the total number of vehicles observed in each fifteen minute interval with the average travel delay during that time. This represents actual hours waiting in traffic queues by the commuting drivers. The difference between the red and green lines represents the hours of “productive" time regained by drivers in each fifteen minute interval. For the city of Bergen, this represents a gain of over 7000 hours per day.

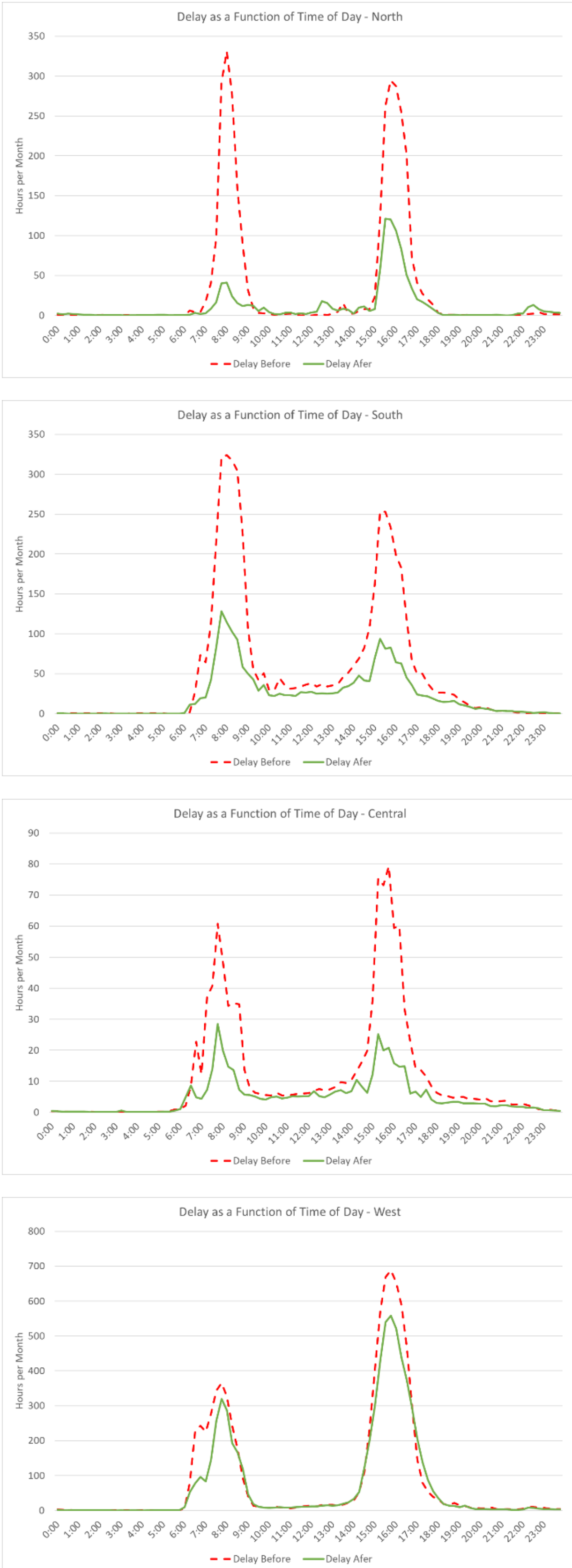


Figure 1: Overall delay and change by aggregate borough

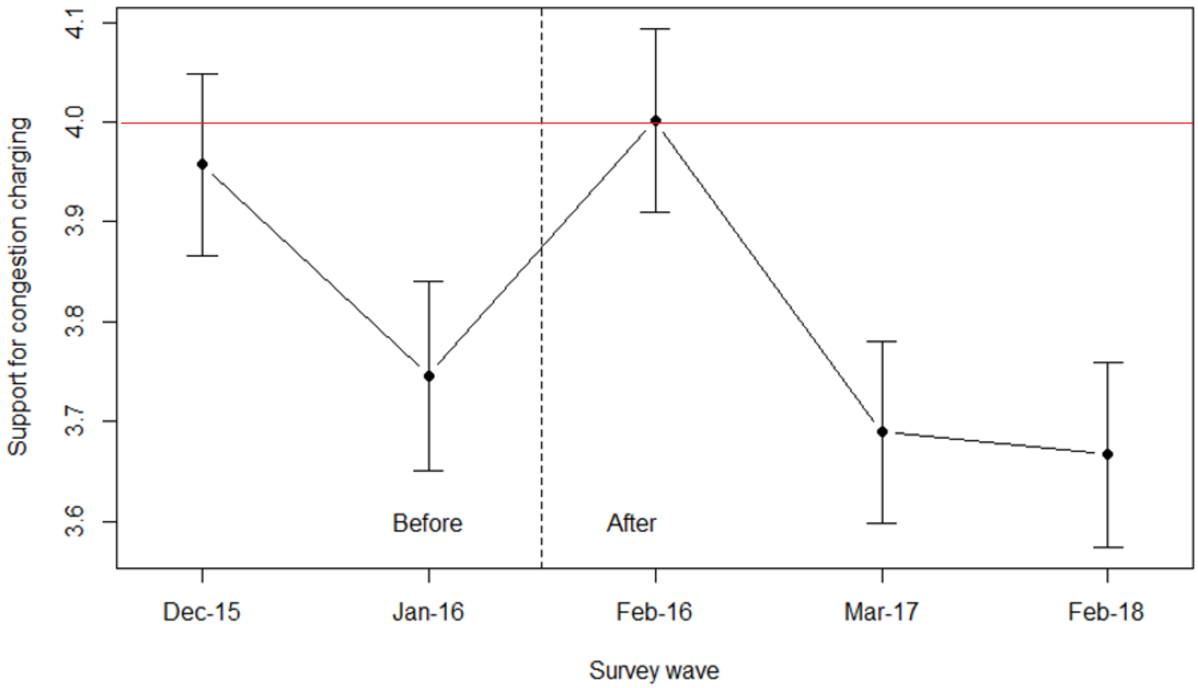
Delay as function of time of day before and after the introduction of congestion charging. See footnote 4 for an explanation of the calculation of delays.

5.2 Attitudes before and after introduction of congestion charging

Was public opinion influenced by the reduced congestion? Figure 2 shows the average levels of public support and opposition before and after implementation in Bergen. Overall, the attitudes show no particular trend. Specifically, the average support level for the two surveys before introduction was 3.85 (s.e. = 0.066), which changed to an average of 3.78 (s.e. = 0.053) in the three surveys after. The difference between the means of support before and after introduction is not statistically significant ($t(2{,}929) = 0.83$, $p \sim 0.41$). While some of the means of the five individual survey waves are statistically separable from each other, the differences in effect sizes are small, only one-third of a step on the 1-7 scale at most. All five rounds have a median response of 4, the central response option indicating neither support nor opposition. Thus, unlike the earlier findings from Stockholm and London, Bergen does not show a clear increase in acceptance after the introduction of congestion charging.

Figure 2:

Attitudes before and after the introduction of congestion charging. The vertical line illustrates the introduction of congestion charging. The horizontal line shows the point of indifference (neither *support nor opposition)*



While aggregate public opinion on congestion charging is relatively stable before and after its introduction, there are some geographical nuances. Figure 3 shows the changes by borough. Five boroughs display increased levels of support, whereas three see declines. Only one or two of these differences are statistically significant: the smallest and easternmost borough of Arna ($t = 2.55$, $p < 0.01$, $n = 101$) and arguably also the western borough of Laksevåg ($t = 1.62$, $p < 0.10$, $n = 321$). Figure 4 shows the same results on the map.

Figure 3

Attitudes before and after the introduction of congestion charging, by borough.

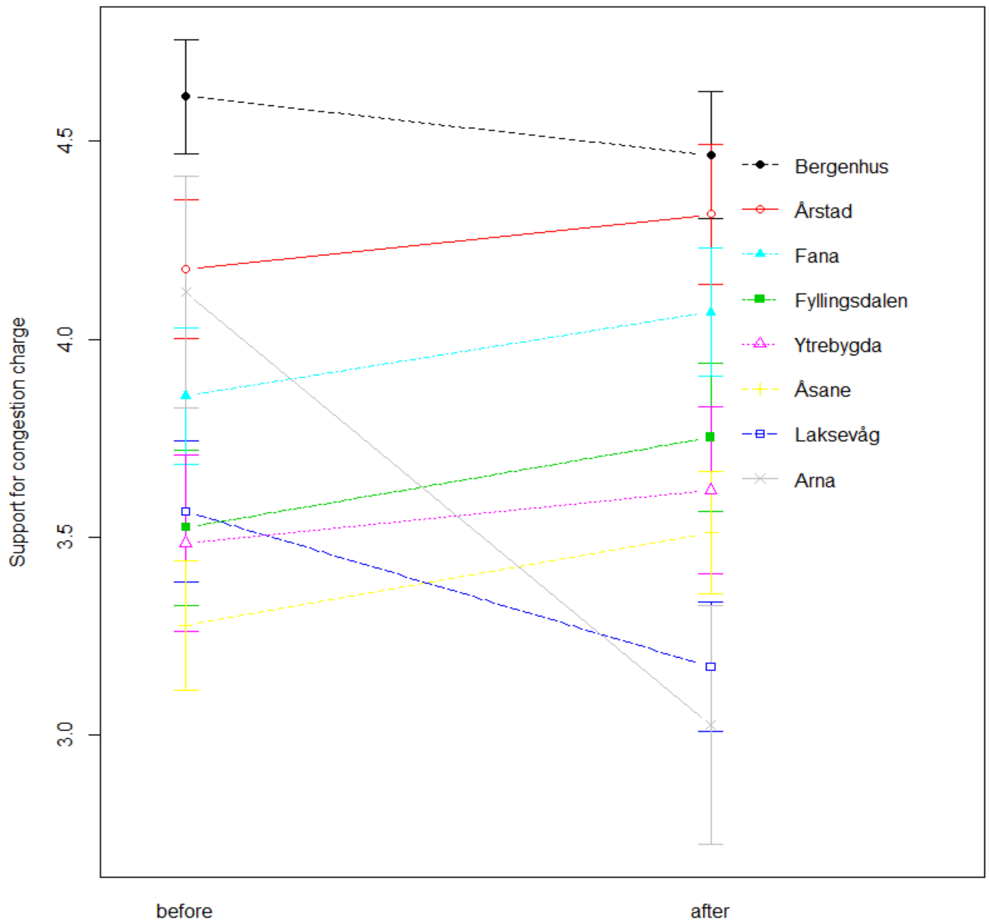
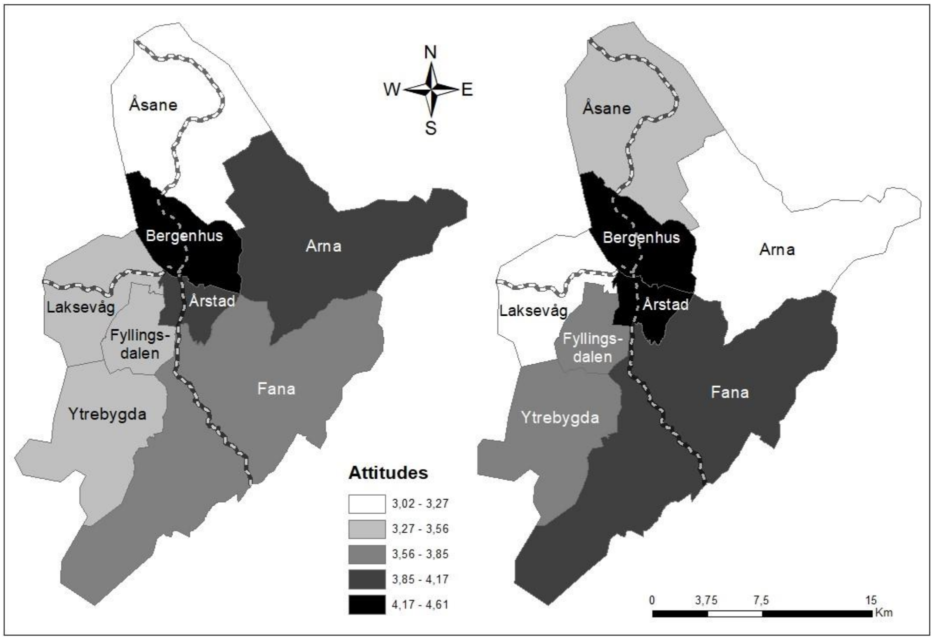


Figure 4

Changes in support/opposition to congestion charging before and after its introduction, by borough. Panel (a) shows average public opinion before and after introduction. Panel (b) shows changes illustrated by color. Main roads linking suburbs to city center shown in gray/dotted lines. North = Åsane, South = Fana, West = Laksevåg, Central = Bergenhus and Årstad. Sources: Data (c) Kartverket; map produced by Kari Elida Eriksen.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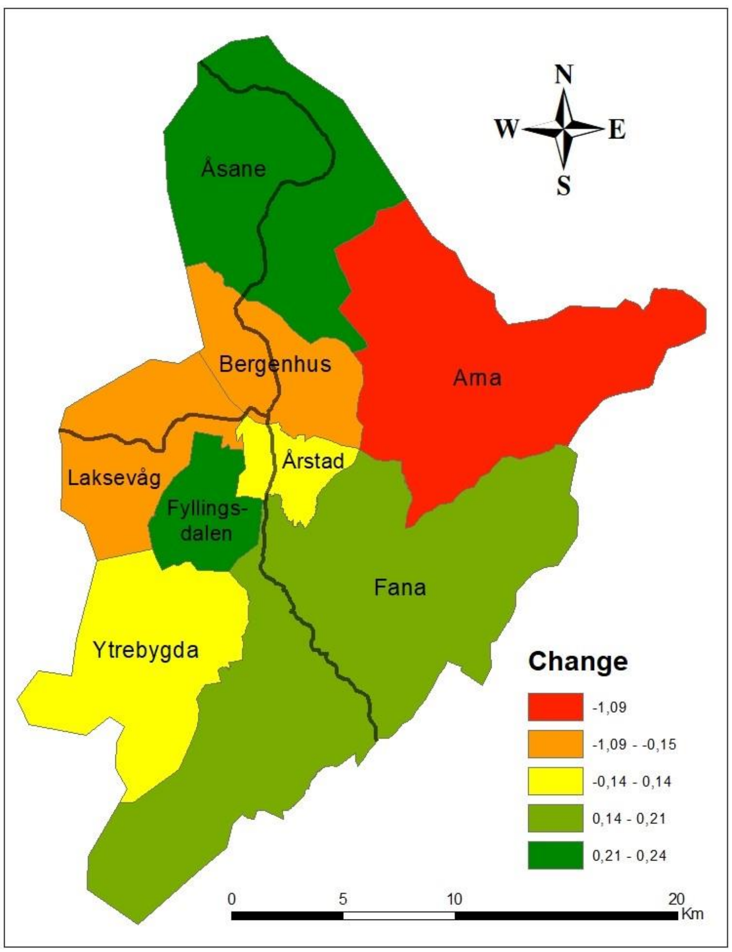
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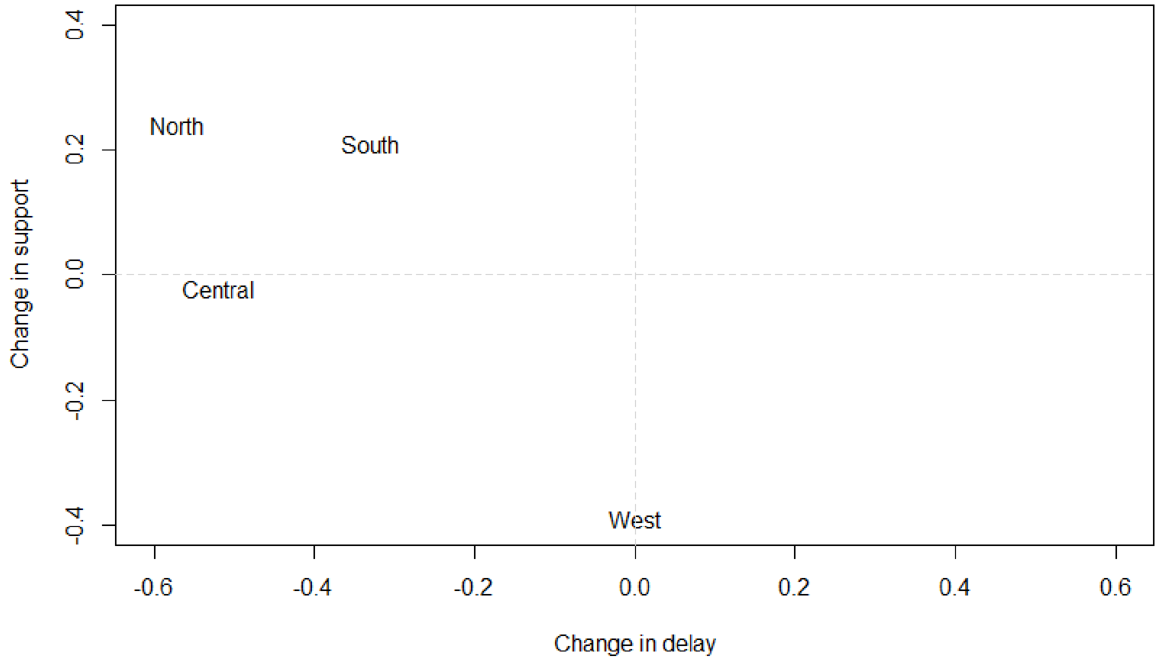
5.3 Links between congestion alleviation and public opinion

To what extent are the differences in changes by borough, as shown in Figures 3 and 4, attributable to the geographically varying material effects of congestion charging, as shown in Figure 1? We combine a summary of these two items in Figure 5. The result is consistent with the conjecture that support for congestion charging will increase more where its positive effects are felt more strongly. Specifically, the Northern suburbs had the greatest reduction in delay and also display the greatest increase in support, whereas Western commuters saw the least benefit and also increased their opposition the most. At the same time, this remains a conjecture as the results have little statistical power.

Figure 5

Average changes in public support (expressed as points on a 1-7 scale) over changes in delay (per cent), before and after the introduction of congestion charging. The boroughs shown are the ones with principal roads (North = Åsane, South = Fana, West = Laksevåg, Central = Bergenhus and Årstad).



5.4 Structure of support and opposition

To what extent can variation in support and opposition to congestion charging be explained by differences in socio-economic characteristics and other variables? To answer this question, we specified a set of multivariate linear regression models summarized in Table 3. All models include basic demographics: gender, age, level of education, and income category. We also include a dummy variable in models 1-3 indicating whether the survey went to the field before or after the introduction of congestion charging. In model 2, we add binary indicators for the eight boroughs. In model 3, a measure of whether people work in the private or public sector is included.

Models 4 and 5 display results for data that were only available in single survey waves. They thus have smaller sample sizes and do not include any effect of the introduction of congestion charging. Model 4 adds a measure of the number of persons in the household, taken from Wave 4 (March 2017), on the conjecture that families with children may face a different time/money trade-off than households without children. Model 5 adds to the basic model a variable of people's preferred mode of transportation (car, bus, light rail, walking/biking, or other mode). This variable was collected in Wave 2 (January 2016).

The regression results show a generally negative effect of age on support for congestion charging, while gender has less clear results. A very strong effect is seen from education, and notably from the highest category of more than six years of secondary education. For this group, Model 1 shows an increase in support by a full step on the 1-7 scale, a result that only weakens somewhat as additional variables are introduced in Models 2 and 3.

By contrast, income has, if anything, a negative effect on support for time-differentiated road tolls. It is, however, smaller than that of education, as a change in one income category on the four-step scale reduces support by 0.11 – 0.14 steps on the support scale in Model 1 and Model 2, respectively. This effect washes out as work sector is introduced in Model 3, suggesting that work in the private sector reduces support by almost one half-step relative to the reference category consisting of respondents who do not work.

Models 4 and 5 have fewer respondents, and their results thus need to be interpreted with some caution. The inclusion of a variable displaying the number of household members in Model 4 does not show any significant effect. To the extent that differences exist, it can be shown that the main contrast lies between households with three or more members on the one hand and households with one or two members on the other.

Finally, the analysis of the effects of preferred means of transportation (Model 5) shows that individuals who walk or use a bike report the highest support for congestion charging, followed by users of light rail, bus, car, and finally other means of transportation. The result suggests other rationales than costs and benefits in terms of money and time, as walkers, bikers and light rail users – the people least affected by either congestion or congestion pricing – show the highest support. Recall, however, that this particular variable was only available before the introduction of congestion charging. New data may thus nuance this picture.

Table 3

Summary of multivariate linear regression analyses for variables predicting opinion on congestion charging

Model no.	1 Coef./Std. err.	2 Coef./Std. err.	3 Coef./Std. err.	4 Coef./Std. err.	5 Coef./Std. err.
Gender	-0.04	-0.04	-0.11	0.14	-0.55**
	(0.09)	(0.10)	(0.10)	(0.19)	(0.20)
Age	-0.01**	-0.00	-0.01	-0.01*	-0.02*
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Education: *(Reference: up to 2 years)*					
4-6 years	0.15	0.12	0.12	0.32	-0.01
	(0.12)	(0.13)	(0.13)	(0.25)	(0.26)
more than 6 years	0.99***	0.90***	0.86***	1.45***	0.47
	(0.12)	(0.13)	(0.13)	(0.25)	(0.28)
Income category	-0.14***	-0.11*	-0.07	-0.06	0.02
	(0.04)	(0.04)	(0.05)	(0.10)	(0.10)
Before/after congestion charge	-0.07	-0.01	-0.02	0.00	0.00
	(0.09)	(0.10)	(0.10)	(.)	(.)
Borough: *(Reference: Bergenhus (Central))*					
Årstad (Central)		-0.23	-0.24	0.05	0.04
		(0.17)	(0.17)	(0.34)	(0.36)
Fyllingsdalen (Southwest)		-0.73***	-0.73***	-0.32	-0.24
		(0.19)	(0.19)	(0.35)	(0.39)
Laksevåg (West)		-0.91***	-0.91***	-1.01**	-0.44
		(0.18)	(0.18)	(0.34)	(0.39)

Fana (South)		-0.45**	-0.43*	0.27	-0.14
		(0.17)	(0.17)	(0.33)	(0.37)
Ytrebygda (Far Southwest)		-0.79***	-0.77***	-0.01	-0.07
		(0.21)	(0.21)	(0.40)	(0.45)
Åsane (North)		-0.89***	-0.89***	-0.30	-0.44
		(0.17)	(0.17)	(0.32)	(0.36)
Arna (East)		-0.64*	-0.63*	-0.93	0.99
		(0.26)	(0.26)	(0.49)	(0.65)
Work: *(Reference: not working)*					
Public sector			-0.10	-0.35	0.17
			(0.16)	(0.31)	(0.32)
Private sector			-0.43**	-0.35	-0.42
			(0.15)	(0.30)	(0.31)
Number of household members				0.22	
				(0.15)	
Preferred mode of transportation *(Reference: Other)*					
Car					0.04
					(0.53)
Bus					0.91
					(0.55)
Light rail					1.32*
					(0.61)
Walk or bike					2.11**
					(0.65)
Constant	4.20***	4.45***	4.84***	3.24***	4.52***
	(0.24)	(0.28)	(0.30)	(0.65)	(0.75)

*[1] coded as 1 = man, 2 = woman, [2] coded as 1 = up to 2 years, 2 = 4-6 years 3 = more than 6 years; [3] coded as 1 = before, 2 = after; [4] coded as 1 = up to NOK 500K, 2 = NOK 500-750K, 3 = NOK 750-1mill, 4 = more than NOK 1 mill; [5] coded as 0 = not public sector, 1= public sector; [6] coded as 0 = not private sector, 1= private sector. [7] coded as 1 = one, 2 = two, 3 = three or more. Significance level: * p<0.05, ** p<0.01, *** p<0.001*

6. Discussion

Examining public opinion, we find that aggregate public opinion about time-differentiated road tolls, referred to here as congestion charging, did not change after its introduction, even though congestion was reduced as a direct result. Specifically, we conducted two studies before the introduction of congestion charging in Bergen in February 2016, and three studies after, with no significant differences in means of public opinion between the two groups of studies. This goes against expectations from cities such as Stockholm and London.

We do, however, find some variation across boroughs. The benefits of congestion charging were mainly seen along the trunk roads leading between the city center and the northern and southern boroughs, whereas the west gained little in terms of reduced traffic delay. In line with this variation, we also found that public support for congestion charging fell in the west – a result with borderline statistical significance – while it increased insignificantly in the north and the south.

These results derive from the study's before/after design, and are not attributable to demographic differences in the cross-sections drawn at different points of time. Regression analysis controlling for demographic factors confirm the lack of aggregate effect from the actual introduction of congestion charging on public support. The strongest effect of demographic variables is seen among individuals with the highest level of education, who support congestion charging by about one step more than the reference group, or about half a standard deviation. Indeed, it can be shown that this group, taken in isolation, responded positively and significantly to the introduction of congestion charging in the aggregate (regression interaction effect = 0.38, s.e.=0.20, p=0.05). This effect could be explained by either greater flexibility in work hours among this group, or alternatively a stronger trust in the ability of experts to solve practical problems such as traffic congestion.

An alternative explanation to the education effect could be that individuals with high levels of education put a higher value on time relative to money. Education correlates positively although weakly with income category (r = 0.26). However, the effect of income in the regression analysis is, if anything, negative. Thus, our data are not consistent with a scenario where wealthier individuals support congestion charging so that they can enjoy free traffic flow at the price of a slightly higher road toll level. Rather, our result is in line with the expectations from Nordheim and co-authors (2010) that wealthier individuals are more likely to cross a road toll charging point during peak hours, and thus more likely to face higher costs.

We also do not see any clear result supporting the hypothesis that families with children are more willing to pay for shorter travel times, for example to be able to transport multiple family members during limited time intervals in the morning and afternoon. While the coefficient on household size is positive, it is not significant. Furthermore, the results show no gender effects, or if anything, lower levels of support among women than among men, controlling for other key variables. These results thus fail to confirm conjectures based on Nordheim, Haug, *et al*. (2010) that families with children will have lower costs from congestion charging as they are less likely to cross a charging point during peak hours, and that women are less likely to cross charging points in general. They also conflict with expectations in the literature that women generally support environmental policies more than men (Davidson and Freudenburg, 1996). The fact that women showed less support for congestion charging overall, when controlling for favored transportation mode, is surprising and requires more study.

We thus see that socio-demographic variables have some effects, some surprising and some in line with theory, but that they cannot offer a general explanation for why there is no aggregate change in public opinion about congestion charging after the policy's introduction. To examine this result, we return to the study by Eliasson and Jonsson (2011), which states that the increase in public support and the referendum success in the Stockholm trial had several explanations, but that the most important factor was people's belief about the charge's effects, in particular on congestion. This is in line with other findings in psychological literature regarding mental models. A mental model is a representation or a set of causal beliefs which occurs when people perceive the surrounding world, and can influence how the person learns, reacts to information, defines a problem, and makes decisions (Gentner and Stevens, 2014 [1983]). Previous research on mental models and energy transition, suggests that people support things they evaluate as effective (Bostrom, 2017). The perceived effects are not to be confused with objective effects, but it seems that achieving objective effects are necessary to increase public support.

By contrast, in Bergen, the public was already familiar with the road toll system, which had been in place since 1986, and which had been subject to numerous political debates covered in detail in the media. Thus, even as road use was made more efficient through the congestion charge, and the reduction in traffic was greater than foreseen by planners, it is likely that large segments of public opinion in Bergen had already been frozen in distinct camps for and against the use of road pricing in general. This is potentially the greatest difference from Stockholm: the congestion charge was not a new and untested concept, but rather a variation on an existing and much-debated policy tool.

7. Conclusions

Congestion charging is a potentially powerful instrument to improve vehicle flow and reduce emissions in cities, but public opposition constitutes a formidable challenge to implementation. In this article we aim to contribute to understanding the question of what explains public opinion on congestion charging, focusing particularly on geographical variation within a city). There have been multiple case studies of cities that have implemented congestion charging or tried to do so, such as Stockholm, Beijing, London, New York (see for example Schaller, 2010; Schuitema, Steg and Forward, 2010; Linn, Wang and Xie, 2016). These have analyzed the changing dynamics of public opinion, but not properly investigated geographical variation.

Our case study of one of the front-runner cities in road pricing, Bergen, shows that success in reducing congestion does not automatically ensure public acceptance of congestion charging. Specifically, while the policy reduced time lost in traffic across Bergen, public support and opposition remained stable before and after the policy was introduced. We furthermore found that levels of support or opposition vary predictably, and sometimes unexpectedly, with factors such as policy effect (varying across geography), favored transportation mode, income levels, and demographic factors, notably gender and age. A theoretical implication is that the explanatory power of status quo bias – the tendency to prefer the current situation over a new and unknown policy setup, but to change one's views once the new policy shows its effects – is limited.

In the Bergen case, public opinion had arguably been mobilized around the issue of road pricing. Specifically, Bergen had already had a flat-fee version of road pricing for 30 years before the introduction of time-differentiated rates. Yet we saw evidence of increased opposition in the Western parts of the city, where the beneficial effect of the congestion charge was the smallest. The geographical variations in public opinion, and the correspondence with observed changes in actual congestion, suggest that intra-city distribution of costs and benefits is of critical importance. Contextual effects such as conflicts between interest groups, perceived injustices in how certain boroughs are disproportionally hit by cost, and details surrounding implementation (such as location of control points) are likely to play major roles for how new policies are perceived. Investment in public transportation appears necessary to provide alternatives to the public, but is no guarantee. In other words, policy makers have to be attentive to how the costs and benefits are distributed between parts of the city, and how this is perceived by the public. For example, toll structures may in some cases need to be flexible enough to accommodate differences in costs and benefits across different parts of the urban area. Furthermore, for congestion charging proposals to translate into implementation, success, and public support, it is not enough to implement and then wait for the public to catch up. Policymakers should seek multiple avenues for making congestion charging as effective as possible while minimizing or compensating for the inevitable costs to given segments of the public.

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